

Trauma Clinical Guideline: Screening of Blunt Cardiac Injury

The Trauma Service Directors' Workgroup is an open forum for the directors of designated trauma services in Washington State to share ideas and concerns regarding the provision of trauma care. The workgroup meets twice a year to encourage communication between services so that they may share information and improve the quality of care that they provide to patients. On occasion, at the request of the Governor's Steering Committee on EMS and Trauma Care, the group discusses the value of specific guidelines for trauma care procedures.

This guideline is distributed by the Washington State Department of Health on behalf of the Governor-Appointed Steering Committee on Emergency Medical Services and Trauma Care to assist trauma care services with the development of their trauma patient care guidelines. Toward this goal the Trauma Service Directors have categorized the type of guideline, the sponsoring organization, how it was developed, and whether it has been tested or validated. It is hoped that this information will assist the physician in evaluating the content of this guideline and its potential benefits for their practice or any particular patient.

The Department of Health does not mandate the use of this guideline. The Department recognizes the varying resources of different services and that approaches that work for one trauma service may not be suitable for others. The decision to use this guideline in any particular situation always depends on the independent medical judgment of the physician. It is recommended that trauma services and physicians that choose to use this guideline consult with the Department or Eastern Association for the Surgery of Trauma, the original developer of the guideline, on a regular basis for any updates to its content. The Department appreciates receiving any information regarding practitioners' experiences with this guideline. Please direct comments to Mary Rotert RN, (360) 705-6729 or mary.rotert@doh.wa.gov

This is a trauma assessment and management guideline. It was adapted from the Eastern Association for the Surgery of Trauma website. The Trauma Medical Directors Workgroup reviewed the guideline, sought input from trauma care physicians throughout Washington State, and used that input to make the indicated changes. The guideline was then endorsed by the Steering Committee, and by the DOH Office of EM/TP. This guideline has not been tested or validated. Further information and the original guideline is available at www.east.org

Practice Management Guidelines for Screening of Blunt Cardiac Injury

EAST Practice Parameter Workgroup for Screening of Blunt Cardiac Injury

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I. Statement of the problem

The reported incidence of blunt cardiac injury (BCI), formerly called myocardial contusion, depends on the diagnostic modality and criteria used and ranges from 8% to 71%. The true incidence remains unknown as there is no diagnostic gold standard. The lack of such a standard leads to confusion with respect to making a diagnosis and makes the literature difficult to interpret. Key issues involve identifying a patient population at risk for adverse events from BCI and then appropriately monitoring and treating them. Conversely, patients not at risk could potentially be discharged from the hospital with appropriate follow-up.

II. Process

A Medline search from January 1986 through February 1997 was performed. All English language citations during this time period with the subject words "myocardial contusion", "blunt cardiac injury", and "cardiac trauma" were retrieved. Letters to the editor, isolated case reports, series of patients presenting in cardiac arrest, and articles focusing on emergency room thoracotomy were deleted from the review. This left 56 articles which were primarily well-conducted studies or reviews involving the identification of BCI.

III. Recommendations

A. Level I

An admission EKG should be performed on all patients in whom there is suspected BCI.

B. Level II

1. If the admission EKG is abnormal (arrhythmia, ST changes, ischemia, heart block, unexplained ST), the patient should be admitted for continuous EKG monitoring for 24 to 48 hours.

Conversely, if the admission EKG is normal, the risk of having a clinically significant BCI is negligible, and the pursuit of diagnosis should be terminated.

2. If the patient is hemodynamically unstable, an imaging study (echocardiogram) should be obtained. If an optimal transthoracic echocardiogram cannot be performed, then the patient should have a transesophageal echocardiogram.
3. Nuclear medicine studies add little when compared to echocardiography and, thus, are not useful if an echocardiogram has been performed.

C. Level III

1. (~~Elderly~~) * Patients with known cardiac disease, unstable patients, and those with an abnormal admission EKG can be safely operated on provided they are appropriately monitored. Consideration should be given to placement of a pulmonary artery catheter in such cases.
2. The presence of a sternal fracture does not predict the presence of BCI and, thus, does not necessarily indicate that monitoring should be performed.
3. Neither creatinine phosphokinase with isoenzyme analysis nor measurement of circulating cardiac troponin T are useful in predicting which patients have or will have complications related to BCI.

IV. Scientific Foundation

In a consensus statement published in the Journal of Trauma in 1992 by Mattox et al, it was felt that the terms "cardiac contusion" and "cardiac concussion" should cease to be used as a diagnosis for admission, injury severity scoring, billing, or reimbursement purposes.³⁹

Alternatively, specific descriptions were recommended and are as follows:

- Blunt cardiac injury with septal rupture
- Blunt cardiac injury with free wall rupture
- Blunt cardiac injury with coronary artery thrombosis
- Blunt cardiac injury with cardiac failure
- Blunt cardiac injury with minor ECG or enzyme abnormality
- Blunt cardiac injury with complex arrhythmia

Based on this recommendation, the following discussion will utilize the term blunt cardiac injury (BCI) as opposed to cardiac contusion or concussion for purposes of clarity.

Clinically, there are few reliable signs and symptoms that are specific for BCI. Many patients have evidence of external chest trauma, such as fractures or the imprint of a steering wheel, or other causative agent on their chest. Chest pain, usually due to associated injuries, is common, and occasionally patients will describe anginal-type pain that is unrelieved by nitrates. The diagnosis is entertained by maintaining a high index of suspicion in patients with an appropriate mechanism of injury or in those who manifest an inappropriate or abnormally poor cardiovascular response to their injury. Well-defined and uniformly accepted diagnostic criteria do not exist, and the optimal diagnostic evaluation remains controversial. At present, no single test or combination of tests has proven consistently reliable in detecting cardiac injury. The diagnosis of BCI will be directly proportional to the aggressiveness with which it is sought. The appropriate choice demands achieving a balance between cost-effectiveness of the tests employed and the impact of the information acquired on clinical management decisions.

EKG

In a meta-analysis of 43 studies published in English from 1967 through 1993, it was found that ECG and CPK-MB analyses were more useful in diagnosing clinically significant BCIs (those that result in a complication that requires treatment) than were radionuclide scans and echocardiograms.⁵³

**Washington trauma physicians recommended the word "elderly" be omitted*

The Pediatric Emergency Medicine Collaborative Research Committee published a multicenter retrospective review of 184 patients admitted with BCI in 1996.⁵² The authors noted that no hemodynamically stable patient who presented with a normal admission ECG developed a cardiac arrhythmia or cardiac failure. The lack of subsequent development of pump failure or serious arrhythmia in hemodynamically stable patients who presented in normal sinus rhythm is evidence that serious, unsuspected acute complications are truly very rare. This agrees with a previous investigation of adults that found clinically significant life-threatening complications after BCI were rare and that patients at risk for such complications can be identified when they present to the emergency department.²⁸ Recommendations from these groups were that stable patients who do not require monitoring for other injuries should only be monitored if there are conduction abnormalities on admission ECG.^{28,52}

In a separate review of hemodynamically stable blunt chest trauma patients with a completely normal ECG and no evidence of additional somatic injury, it was concluded that no further testing for BCI was required.⁴⁹ In-hospital monitoring should be reserved for patients with clinical evidence of dysfunction or in whom significant arrhythmias were apparent. Likewise, several other studies have confirmed that stable patients with a normal admission ECG require no further work-up with respect to BCI.^{20,22,24,31,35,38,41,42,45,48} In a prospective evaluation of 100 patients admitted to a level 1 trauma unit with a clinical suspicion of BCI, it was recommended that if patients were hemodynamically stable, less than 55 years of age with no history of cardiac disease, required no surgery or neurological observation, and had a normal admission ECG, they could be discharged to home.⁴⁸ If patients did not meet one or more of the above mentioned criteria, cardiac monitoring for 24 hours was recommended with treatment as necessary.⁴⁸ Although 74% of patients did not meet one or more of the criteria, no patient developed a complication requiring therapy. It was felt that limiting the cardiac evaluation in these patients to an admission ECG and 24 hours of monitoring would greatly reduce the cost of care without increasing the risk of missing potentially serious complications. In a separate prospective evaluation of 336 patients with suspected BCI, Cachecho et al. concluded that young trauma victims without major thoracic or extrathoracic injury and a normal admission ECG do no benefit from admission to the SICU, routine echocardiography, or radionuclide studies.³⁵ The authors also stated that young, minimally injured patients with an abnormal admission ECG are unlikely to develop subsequent cardiac decompensation and that a brief period of monitored observation may be indicated. Cardiac imaging studies should only be requested to answer specific clinical questions that cannot otherwise be explained and are not useful to confirm the diagnosis of myocardial contusion in a stable patient or for screening purposes. McLean et al., in a prospective analysis of outcome of 312 patients with blunt chest trauma, noted that there were no deaths secondary to dysrhythmias or cardiac failure and felt that the incidence of clinically significant dysrhythmias or other cardiac complications resulting from blunt trauma to the heart may be overestimated.⁴⁰ The authors recommended ECG monitoring only if dysrhythmias were documented on admission ECG or if the patient was unstable. Enzyme analysis and routine RNA studies were not useful. In a separate meta-analysis by Christensen, the admission ECG was seen as the most important diagnostic tool in determining the presence of BCI.⁴¹ The authors identified and reviewed 18 studies from January 1986 through January 1992 noting that 80% of all arrhythmias requiring treatment were present in the emergency department. Later arrhythmic events, such as those described by Foil et al., and Norton et al., were usually ascribed to pre-existing cardiac disease or myocardial infarction.^{24,26,41} Both Foil and Norton suggest that an abnormal ECG requires further investigation as these are the patients at risk for sequelae.^{24,26}

Enzyme Analysis

While several studies suggest that CPK isoenzyme analysis may be useful in determining which patient would benefit from further imaging studies,^{1,21,47} the overwhelming majority of studies conclude that such analysis is not warranted.^{3,5,9,10,12,14,15,17,22,28-31,38,40-43,49} Keller et al., in a retrospective evaluation of 182 patients, noted no correlation between an abnormal isoenzyme and ECG and went on to recommend a MUGA scan in patients with an abnormal ECG or pump failure.¹⁷ Fabian et al., in a prospective evaluation of 92 patients with evidence

of anterior chest trauma, concluded that CPK-MB determinations should not be routinely used for screening and diagnosis of BCI.²⁹ Biffi et al., in a retrospective analysis of 359 patients admitted with a diagnosis of rule out BCI, noted that an abnormal admission ECG was the most significant independent predictor of a complication of myocardial contusion while isolated elevations in cardiac enzymes did not predict complications from BCI.⁴³ The authors, in fact, concluded that cardiac enzymes were irrelevant in the patient with suspected myocardial contusion. More recently, the use of cardiac troponin I (cTnI) has been suggested as a screening test for BCI.⁵⁰ In an effort to determine whether its measurement would improve the ability to detect cardiac injury in patients with blunt chest trauma, 44 patients were studied with serial echocardiograms and serial blood samples.⁵⁰ Six patients had evidence of cardiac injury by echocardiography, and all had elevations of CPK-MB and cTnI while one patient with elevations of both enzymes had only pericardial effusion; 26 of 37 patients without contusion had elevations of CPK-MB but not cTnI. The authors concluded that measurement of cTnI accurately detects cardiac injury in patients with blunt chest trauma. It should be noted that all 6 patients with evidence of cardiac injury had abnormal admission ECGs, and that in two cases the injury was felt to be due to infarct rather than trauma. Based on this data, it appears as though cTnI did not contribute significantly to management of these patients. In a more recent prospective study, it was concluded that circulating cardiac troponin T has no important clinical value in the diagnosis of BCI.⁵⁶

Echocardiogram

Almost all of the data analyzed suggest that echocardiography is not useful as a primary screening modality, however, should be recommended as a complementary test in selected patients.^{2,9,28,30,35,38,41,44,45,51,52} Specifically, it has been emphasized that echocardiography adds little in hemodynamically stable patients but rather should be reserved for those with clinical compromise in which specific clinical questions cannot be explained.^{15,35,41,44,45,52} In a prospective evaluation of 96 patients with blunt chest trauma, Helling et al. suggested that ECG, CPK-MB, and echocardiography should be routinely performed within 24 hours of admission.²¹ It must be noted, however, that no patient in this study developed complications related to BCI. In a meta-analysis, Christensen et al. found that while no data supported echocardiography for the diagnosis of BCI, it was useful in several instances for the diagnosis of apical thrombi, localization of pericardial effusions, and identification of cardiac structural abnormalities.⁴¹ In a prospective study of 105 consecutive patients with severe blunt chest trauma, Karalis et al. evaluated the role of echocardiography and found that screening echocardiography was not of value as most patients remain asymptomatic.⁴⁴ The authors did state that a transthoracic echocardiogram should be performed in any patient who develops symptoms or has abnormal results on physical exam that suggest underlying cardiac disease. Further, if the transthoracic echocardiogram is suboptimal, a transesophageal echocardiogram should be performed. This is in accordance with Brooks et al.'s prospective evaluation of 50 patients and Weiss et al.'s retrospective review of 81 patients with suspected BCI which showed that, overall, transesophageal echocardiography more accurately detected BCI than transthoracic evaluations because of the suboptimal results encountered with some of the transthoracic studies.^{34,54} Malangoni et al.'s retrospective study confirmed that echocardiogram is useful in patients with arrhythmias or cardiac failure.⁴⁵ The pediatric data likewise noted that echocardiography was a sensitive diagnostic tool for hemodynamically significant disease and should be performed promptly when patients have unexplained hypotension, abnormal ECG, or evidence of pump failure.^{51,52}

Other Imaging Studies

Radionuclide imaging has not been shown to be useful on a routine basis and in several studies has been shown to add no benefit over ECG or echocardiography.^{18,20,35,41,53} MUGA scans have not been shown to be useful in predicting complications from BCI however, in one study was recommended if patients had an abnormal ECG or pump failure.^{17,30} In this study, no comparison was made with echocardiography.¹⁷ Abnormal thallium-201 scanning was shown to correlate with abnormal ECG, but was no better than echocardiography with respect to the prediction of complications from BCI.¹³ SPECT scanning was shown to be a useful predictor of the development of arrhythmias secondary to BCI in two studies, however, in another, admission ECG was shown

to be a better predictor of outcome.^{32,36,55} Lastly, one study evaluating antimyosin scintigraphy showed potential of this modality as a second line test.³⁷ In all, these other modalities require further investigation and at this time cannot be recommended over ECG and selected echocardiography.

Pulmonary Artery Catheter

Several studies evaluated the use of invasive monitoring in patients with suspected BCI, recommending that in certain populations, (i.e. age greater than 60, hemodynamic instability, multisystem trauma, those with abnormal ECGs, and those who are going to receive general anesthesia) a preoperative pulmonary artery catheter should be placed and monitoring continued based on clinical judgement.^{12,22,23,47} Based on these studies, the use of invasive monitoring should be considered in these patient populations.

V. Summary

In general, the diagnosis of BCI should be suspected in patients with an appropriate mechanism of injury or in those who manifest an inappropriately or abnormally poor cardiovascular response to their injury. At present, no single test or combination of tests has proven consistently reliable in detecting cardiac injury. The diagnosis of BCI will be directly proportional to the aggressiveness with which it is sought. The appropriate choice demands achieving a balance between cost-effectiveness of the tests employed and the impact of the information acquired on clinical management decisions.

VI. Future Investigation

Future studies should focus on patients who develop complications secondary to BCI. Diagnostic testing should be compared with the less invasive and less expensive tests currently recommended. A cost-benefit analyses should be considered in all future studies.

Complete references available at www.east.org or from:

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